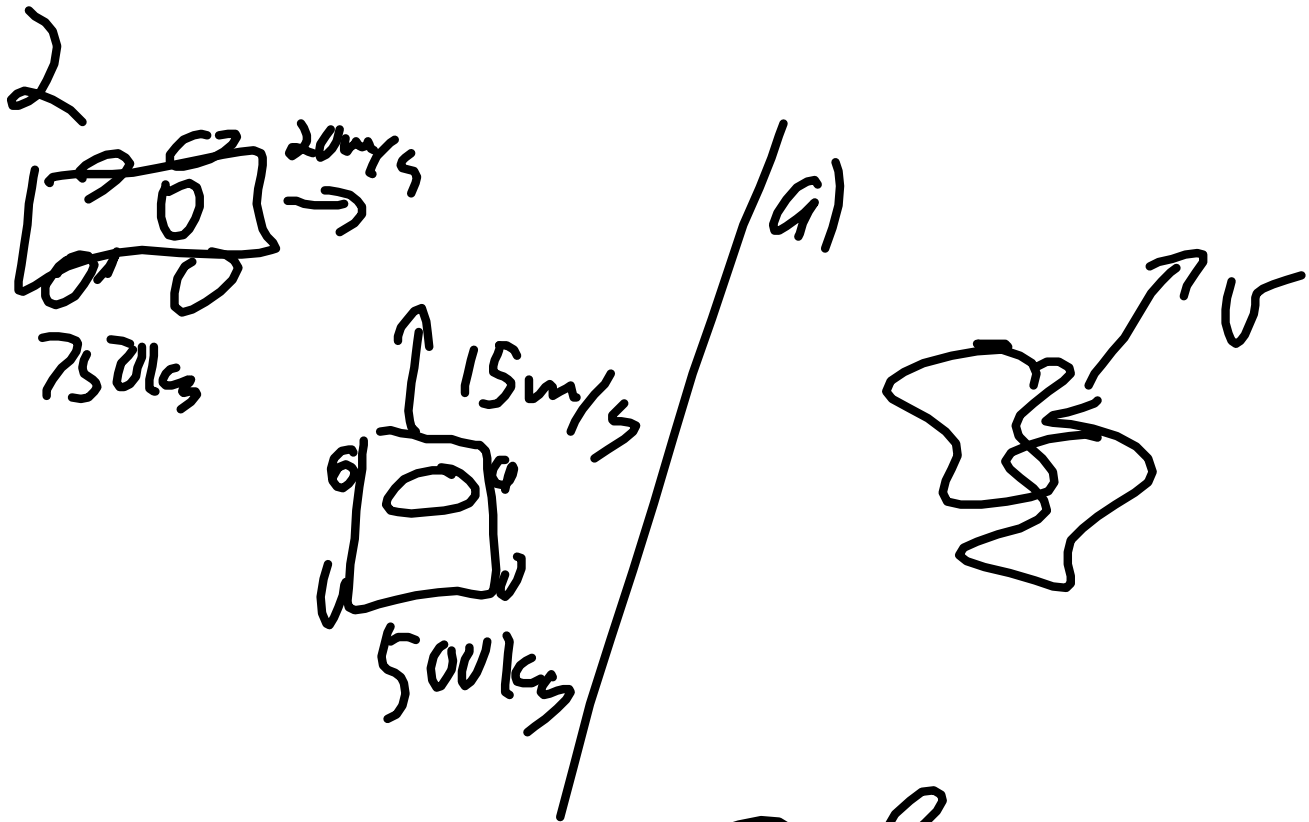


1. A 1.0 kg cart is moving at 2.0 m/s and
 - a) you drop a 1.0 kg mass on it. What is the i) final velocity of the cart
ii) impulse on the cart
 - b) the 1.0 kg cart moving at 2.0 m/s hits a 2.0 kg cart moving at -3.0 m/s. What is the final velocity and impulse on the 1.0 kg cart if i) stick together ii) the collide elastically (kinetic energy is conserved)
1. a 10.0 kg bomb explodes into 3 pieces. A 3.0 kg chunk goes North at 15.0 m/s, a 5.0 kg chunk at 10.0 m/s 30.0° South of East. Determine the velocity and direction of the 2.0 kg chunk.
2. 500.0 kg car moving North at 15.0 m/s hits a 750.0 kg car moving East at 20.0 m/s. Determine the final velocity of the 500.0 kg car and impulse on the car if

- a) they stick together
 b) the 750.0kg car bounces off at 10.0 m/s at 20.0° North of East.



$$\sum p_i = \sum p_f$$

↑
vector sum

$$p = 750 \times 20 = 15000 \text{ Ns}$$

$p = mv$
 $= 500 \times 15$
 $= 7500 \text{ Ns}$

$p_f = (500 \text{ kg} + 750 \text{ kg}) v$

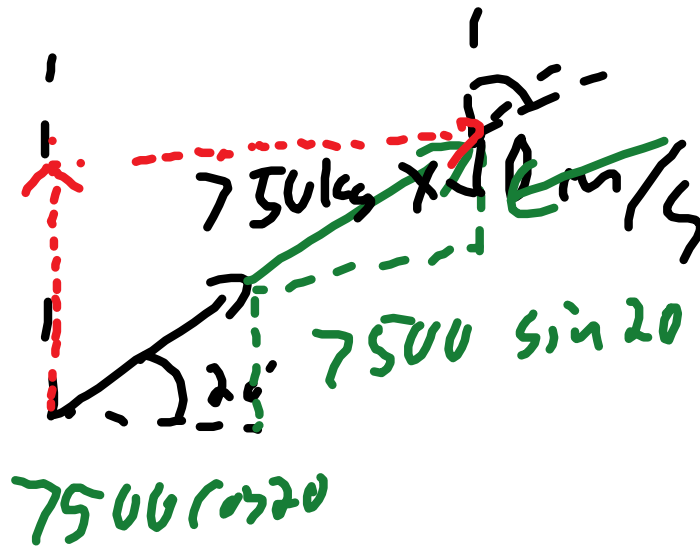
θ

$$= 7500 \text{ N}_s$$

$$7500^2 + 15000^2 = (12500 \text{ V})^2$$

$$\tan \theta = \frac{15000}{7500} \quad \boxed{V = 134 \text{ m/s } 63^\circ \text{ E.F.N}}$$

b)



$$\Sigma P_x = 7500 \cos 20 + P_x = 15000 \text{ N}_s$$

$$\Sigma P_y = 7500 \sin 20 + P_y = 7500 \text{ N}_s$$

$$P_x = 7952 \text{ N}_s$$

$$P_y = 4935 \text{ N}_s$$

$$P_f = \sqrt{P_x^2 + P_y^2} = 9358.81 \text{ N}$$

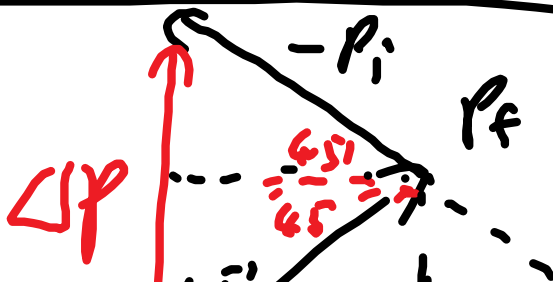
$$V = 18.7 \text{ m/s}$$

$$\theta = \tan^{-1} \frac{P_y}{P_x} = \underline{58^\circ \text{ E of N}}$$

P 169 Q 17, 25, 27, 29, 61



$$\Delta p = P_f - P_i$$



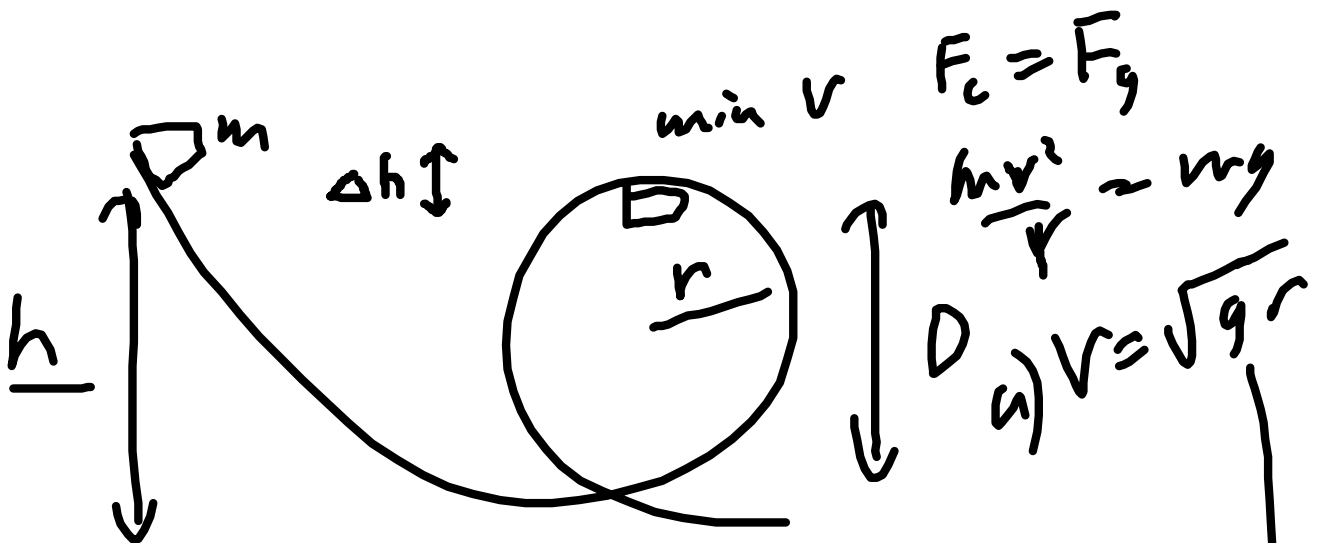
$$\sin 45 = \frac{P_i}{\Delta p}$$



$$\Sigma P_y = mv \sin 45' + mv \sin 45 = \Delta P$$

$$= \sqrt{2} mv \quad \Delta P = \frac{mv}{\sin 45}$$

Energy Quiz



b) ~~$\Sigma E_i = \Sigma E_f$~~

$$\Delta E_g = \Delta E_k$$

$$mg(h - r) = \frac{1}{2}mv^2$$

$$mg(h-D) = \frac{1}{2}mv^2$$

$$h = D + \frac{1}{2} \frac{v^2}{g}$$

$$h = D + \frac{1}{2} \frac{v^2}{g} = \frac{5}{2}r$$

c) total Energy is conserved

$$\underline{mg(h-D) = \frac{1}{2}mv_f^2 - F_f d}$$

↑ path length

Q 2 a) $g = \frac{F_g}{m} = \frac{GMm}{r^2} \cdot \frac{1}{m}$

$$g = \frac{GM}{r^2} = \frac{6.67 \times 10^{-11} \left(\frac{\text{Mass}}{\text{of Planet}} \right)}{(\text{radius})^2}$$

b) $r = \sqrt{\frac{GMm}{L}}$

$$b) E_g = \frac{-GMm}{r} \quad \text{rel to } \theta \text{ at } \infty$$

$$c) \Delta E_g = -GMm \left(\frac{1}{r_f} - \frac{1}{r_i} \right)$$

$$\text{Not } mgh$$

$$d) F_c = \bar{F}_g$$

$$\frac{mv^2}{r} = \frac{GMm}{r^2}$$

1. A 1.0 kg cart is moving at 2.0 m/s and
 - a) you drop a 1.0 kg mass on it. What is
 - i) final velocity of the cart
 - ii) impulse on the cart
 - b) the 1.0kg cart moving at 2.0 m/s hits a

2.0 kg cart moving at -3.0m/s what is the final velocity and impulse on the 1.0kg cart if i) stick together ii) the collide elastically(kinetic energy is conserved)

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 - a) they stick together
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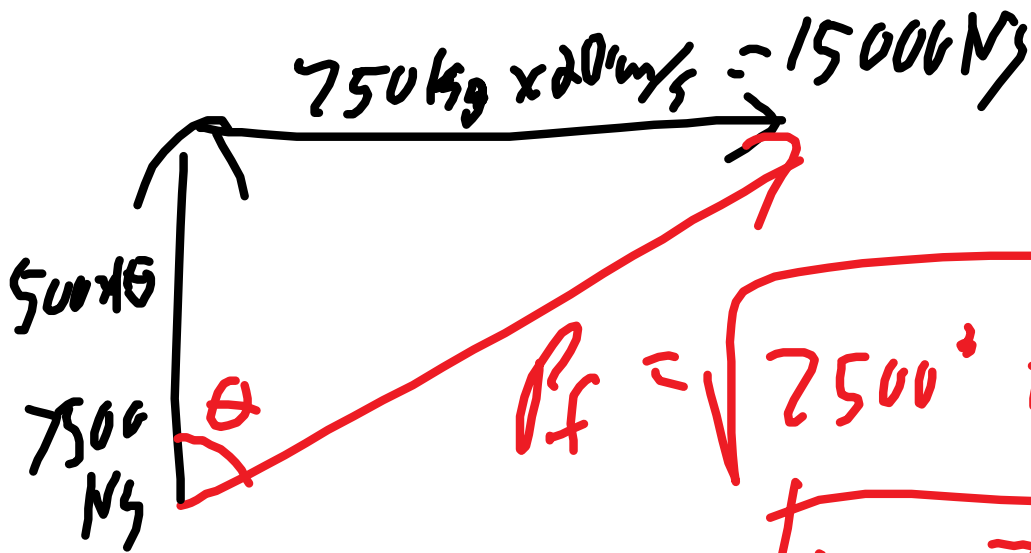
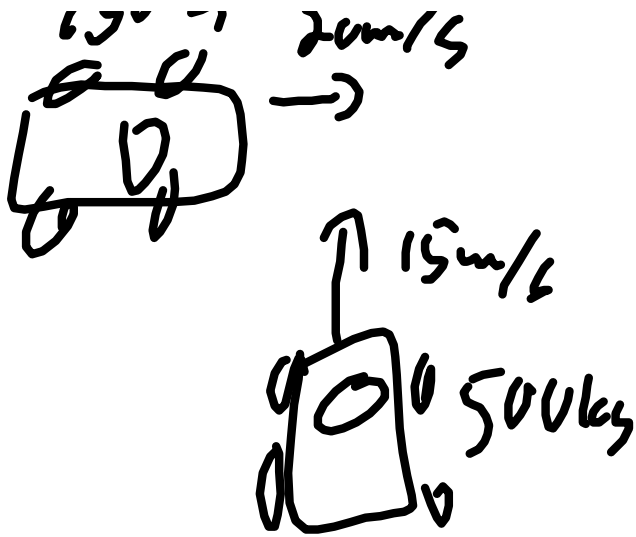
Big Idea

$$\sum \vec{p}_i = \sum \vec{p}_f$$

\uparrow \vec{p}_i \uparrow \vec{p}_f
 \vec{v}_{center} \vec{v}

750kg 20m/s

~~600~~ \rightarrow



$$P_f = \sqrt{2500^2 + 15000^2}$$

$$P_f = \boxed{16770 \text{ kg m/s}}$$

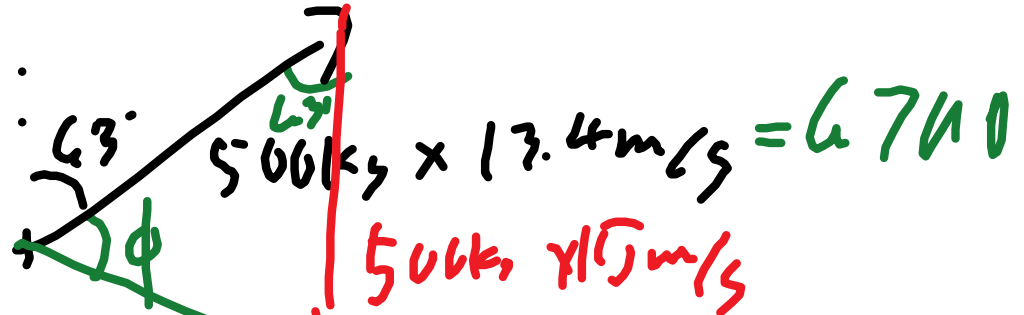
$$V = \frac{P}{m} = 13.4 \text{ m/s}$$

$$\theta = \tan^{-1} \frac{15000}{7500} = \boxed{63^\circ \text{ E of N}}$$

$$\underline{\text{impulse}} = \Delta P = F_{\text{net}} \Delta t$$

$$\underline{\text{Impulse}} = \Delta P = t_{\text{net}} \Delta J$$

$$P_f - P_i \quad \leftarrow \text{of one car}$$



Cosine law

$$\Delta P^2 = 7500^2 + 6700^2 - 2(7500)(6700) \cos 63^\circ$$

$$\Delta P = 7451 \text{ N s}$$

$$7.5 \times 10^3 \text{ N s}$$

$$\frac{\sin \phi}{7500} = \frac{\sin 63^\circ}{7451} \quad \underline{\phi = 63.8^\circ}$$

$$180 - 63.8 - 63 = 53$$

$$\boxed{53 \text{ E of S}}$$

$$b) \sum P_{x_i} = \sum P_{x_f}$$

$\frac{750 \text{ kg} \times 10 \text{ m/s}}{20^\circ}$

$$\sum P_{y_i} = \sum P_{y_f}$$

$$X \quad 15000 \text{ N}_s = 750 \times 10 \cos 20^\circ + P_{x_f}$$

$$Y \quad 7500 \text{ N}_s = 750 \times 10 \sin 20^\circ + P_{y_f}$$

$$P_{x_f} = 7952.3 \text{ N}_s$$

$$P_{yf} = 4\,934.8 \text{ Ns}$$

$$P_f = \sqrt{P_x^2 + P_y^2} = 9\,359 \text{ N}$$

$$V = \frac{P}{m} = 18.7 \text{ m/s}$$

$$\theta = \tan^{-1} \frac{P_x}{P_y} = 58^\circ \text{ E of N}$$

Energy Quiz

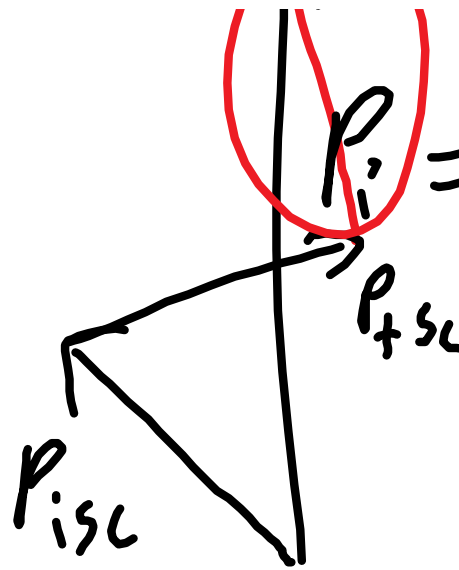
$$\sum E_{ki} - \sum E_{kf}$$

$$\sum P_x$$

$$\sum P_y$$



... 1 ...



The diagram shows a vertical line representing a fluid surface. A point on this line is labeled P_i and is circled in red. Below it, a point is labeled P_{+sc} . To the left, a point is labeled P_{isc} . A horizontal arrow points from P_{+sc} to the right. A vertical arrow points down from P_{+sc} to a point labeled G . A horizontal arrow points from G to the right, labeled v . A dashed line connects P_i to G . The vertical distance between P_{+sc} and G is labeled h . The horizontal distance between P_{+sc} and G is labeled d . The angle between the vertical line and the dashed line is labeled α . The angle between the horizontal line and the dashed line is labeled β .

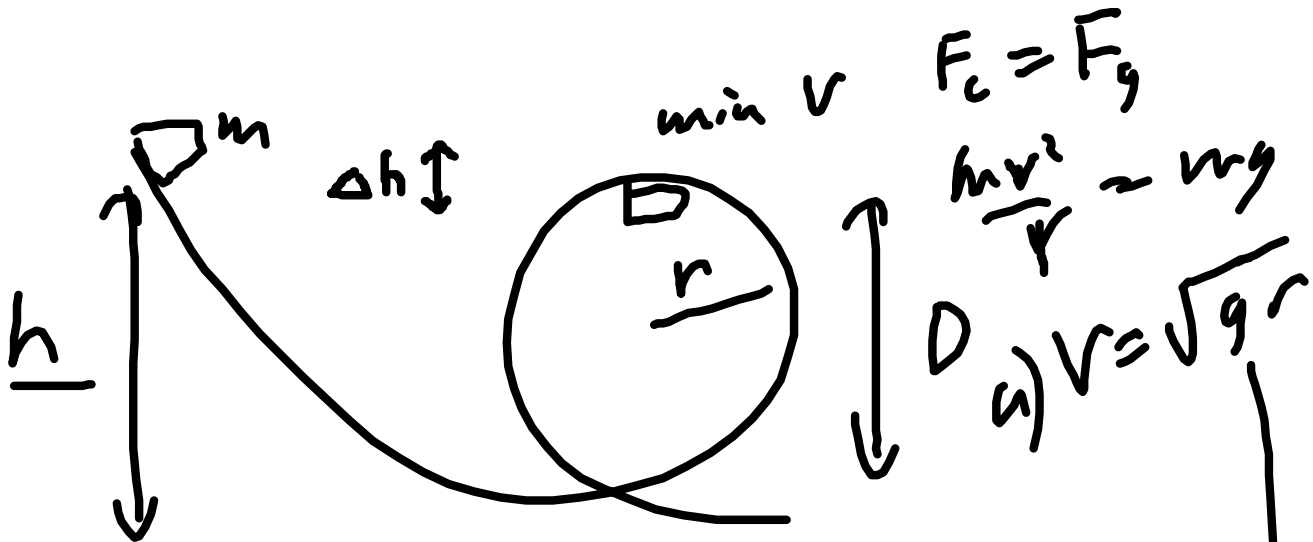
$$P_i = m_i \frac{d \cdot v}{\sqrt{\frac{2h}{g}}}$$

$V_i = 0$

$d = \frac{1}{2} g t^2 = h$

$t =$

Energy Quiz



b) ~~$\sum E_i = \sum E_f$~~

$$\Delta E_g = \Delta E_k$$

$$m g (h - D) = \frac{1}{2} m v^2$$

$$h = D + \frac{1}{2} \frac{v^2}{g}$$

$$h = D + \frac{1}{2} \frac{g r}{g} = \frac{5}{2} r$$

c) total Energy is conserved
 $\underline{mgh - \frac{1}{2}mv_f^2} - \underline{F_f d}$
 ↑ path length

Q2 a) $g = \frac{F_g}{m} = \frac{GMm}{r^2}$
 $g = \frac{GM}{r^2} = \frac{6.67 \times 10^{-11} \left(\frac{\text{Mass}}{\text{of planet}} \right)}{(\text{radius})^2}$

b) $E_g = \left(\frac{-GMm}{r} \right)$ rel to
0 at ∞

c) $\Delta E_g = -GMm \left(\frac{1}{r_f} - \frac{1}{r_i} \right)$

$$N_{ut} mgh$$

d)

$$F_c = \bar{F}_g$$

$$\frac{mv^2}{r} = \frac{GMm}{r^2}$$

work to i) get in to orbit ii) keep in orbit

i) $W = \text{change in gravitational energy} + \text{kinetic energy}$
 $= \text{solution to c} + \frac{1}{2} m(\text{solution to d})^2$

ii) F is perpendicular to d at every instant, so $W=0$.

Q3

a) $mg(h+x) = \frac{1}{2} kx^2$

b) $ma = F_{\text{elas}} - F_g$
 $a = (|kx| - |mg|)/m$